

TRANSMITTAL LETTER TO THE UNITED STATES  
DESIGNATED/ELECTED OFFICE (DO/EO/US)  
CONCERNING A FILING UNDER 35 U.S.C. 371

**FORSAL-35**

U S APPLICATION NO. (If known, see 37 CFR 1.5)

10/069203

INTERNATIONAL APPLICATION NO.  
PCT/FI00/00690

|                           |
|---------------------------|
| INTERNATIONAL FILING DATE |
| 14 August 2000 (14.08.00) |

|                           |
|---------------------------|
| PRIORITY DATE CLAIMED     |
| 24 August 1999 (24.08.99) |

TITLE OF INVENTION  
METHOD AND ARRANGEMENT FOR SURFACE TREATMENT OF A PAPER AND/OR BOARD WEB

APPLICANT(S) FOR DO/EO/US KOIVUKUNNAS, Pekka and LARES, Matti

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.
4. ☒ The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
  - a. ☒ is attached hereto (required only if not communicated by the International Bureau).
  - b. ☐ has been communicated by the International Bureau.
  - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☐ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
  - a. ☐ is attached hereto.
  - b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
  - a. ☐ are attached hereto (required only if not communicated by the International Bureau).
  - b. ☐ have been communicated by the International Bureau.
  - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
  - d. ☐ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371 (c)(3)).
9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ An English language translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

**Items 11 to 20 below concern document(s) or information included:**

11. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A FIRST preliminary amendment.
14. ☐ A SECOND or SUBSEQUENT preliminary amendment.
15. ☒ A substitute specification.
16. ☐ A change of power of attorney and/or address letter.
17. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
18. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
19. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
20. ☐ Other items or information:

|  |  |  |  |  |  |
|--|--|--|--|--|--|
| U.S. APPLICATION NO. (if known, see 37 CFR 1.51)<br><b>107069203</b> |  | INTERNATIONAL APPLICATION NO.<br><b>PCT/FI00/00690</b> |  | ATTORNEY'S DOCKET NUMBER<br><b>FORSAL-35</b> |  |
|--|--|--|--|--|--|

|   |                     |                     |                  |                                  |         |
|---|---------------------|---------------------|------------------|----------------------------------|---------|
| <b>21. <input checked="" type="checkbox"/> The following fees are submitted:</b><br><b>BASIC NATIONAL FEE (37 CFR 1.492(a)(1)-(5)):</b><br>Neither international preliminary examination fee (37 CFR 1.482)<br>nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO<br>and International Search Report not prepared by the EPO or JPO ..... <b>\$1040.00</b><br><br>International preliminary examination fee (37 CFR 1.482) not paid to<br>USPTO but International Search Report prepared by the EPO or JPO ..... <b>\$890.00</b><br><br>International preliminary examination fee (37 CFR 1.482) not paid to USPTO<br>but international search fee (37 CFR 1.445(a)(2)) paid to USPTO ..... <b>\$740.00</b><br><br>International preliminary examination fee (37 CFR 1.482) paid to USPTO<br>but all claims did not satisfy provisions of PCT Article 33(1)-(4) ..... <b>\$710.00</b><br><br>International preliminary examination fee (37 CFR 1.482) paid to USPTO<br>and all claims satisfied provisions of PCT Article 33(1)-(4) ..... <b>\$100.00</b><br><b>ENTER APPROPRIATE BASIC FEE AMOUNT =</b> |                     |                     |                  | <b>CALCULATIONS PTO USE ONLY</b> |         |
|   |                     |                     |                  | \$                               | 1040.00 |
| Surcharge of <b>\$130.00</b> for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input type="checkbox"/> 30<br>months from the earliest claimed priority date (37 CFR 1.492(e)).   |                     |                     |                  | \$                               | 0.00    |
| <b>CLAIMS</b>   | <b>NUMBER FILED</b> | <b>NUMBER EXTRA</b> | <b>RATE</b>      | \$                               |         |
| Total claims  | 8 - 20 =            | 0                   | x <b>\$18.00</b> | \$                               | 0.00    |
| Independent claims  | 4 - 3 =             | 1                   | x <b>\$84.00</b> | \$                               | 84.00   |
| MULTIPLE DEPENDENT CLAIM(S) (if applicable)   |                     |                     |                  | \$                               | 0.00    |
|   |                     |                     |                  | \$                               | 1124.00 |
| <input type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above<br>are reduced by 1/2.   |                     |                     |                  | \$                               | 0.00    |
| <b>SUBTOTAL =</b>   |                     |                     |                  | \$                               |         |
| Processing fee of <b>\$130.00</b> for furnishing the English translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30<br>months from the earliest claimed priority date (37 CFR 1.492(f)).  |                     |                     |                  | \$                               |         |
| <b>TOTAL NATIONAL FEE =</b>   |                     |                     |                  | \$                               |         |
| Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be<br>accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). <b>\$40.00</b> per property +  |                     |                     |                  | \$                               | 0.00    |
| <b>TOTAL FEES ENCLOSED =</b>  |                     |                     |                  | \$                               | 1124.00 |
|   |                     |                     |                  | Amount to be<br>refunded:        | \$      |
|   |                     |                     |                  | charged:                         | \$      |

a. ☒ A check in the amount of \$ 1124.00 to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. \_\_\_\_\_ in the amount of \$ \_\_\_\_\_ to cover the above fees.  
A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any  
overpayment to Deposit Account No. 15-0660 A duplicate copy of this sheet is enclosed.

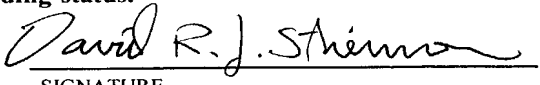
d. ☐ Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. **Credit card  
information should not be included on this form.** Provide credit card information and authorization on PTO-2038.

**NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137 (a) or (b)) must be filed and granted to restore the application to pending status.**

SEND ALL CORRESPONDENCE TO:

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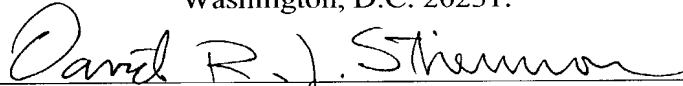
  
 SIGNATURE  
 David R.J. Stiennon  
 NAME  
 33212  
 REGISTRATION NUMBER

## In The United States Patent And Trademark Office

Applicant: Pekka Koivukunnas et al. Date: February 22, 2002  
Date Filed: Simultaneously herewith Docket No.: FORSAL-35  
PCT App. No.: PCT/FI00/00690  
For: Method and Arrangement for Surface Treatment of a Paper and/or Board Web

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Washington, D.C. 20231.



Signature

David R. J. Stiennon, Reg. No. 33212

Name of applicant, assignee or Registered Representative

## Preliminary Amendment

Assistant Commissioner for Patents  
Washington, D.C. 20231

Dear Sir:

Prior to examination of the above application, please amend the application as follows.

## In the Specification:

Please amend the specification as shown on the accompanying Clean Copy of Substitute Specification. A Marked Up Copy of Substitute Specification is also provided, as well as a statement as to lack of new matter under 37 C.F.R. 1.125(b)(1).

## In the Claims:

Please cancel claims 1-6, and add the following new claims:

Applicant: Pekka Koivukunnas et al.  
PCT App. No.: PCT/FI00/00690

7. A method for surface treatment of a paper and/or board web in a paper or board machine including a yankee cylinder followed by a calendering unit, wherein the web is glazed and dried first by means of the yankee cylinder, after which the web is immediately calendered by means of a shoe or extended-nip calendering unit.

8. The method of claim 7 wherein when it is intended to achieve a given paper or board quality, the difference between the running speed used and the maximum running speed dependent on the evaporation capacity of the yankee cylinder is compensated for by means of calendering, the calendering after the yankee cylinder enabling the running speed of the yankee cylinder to be increased without the quality in the form of the gloss and smoothness of the paper or board suffering.

9. The method of claim 7 wherein a surface of the web glazed by the yankee cylinder is glazed in the calendering unit.

10. An arrangement for surface treatment of paper and/or board in a paper or board machine including a yankee cylinder followed by a calendering unit wherein the arrangement is formed of a combination in which there is disposed in the machine direction first a yankee cylinder and then a calendering unit, which is formed by a shoe or extended-nip calendering unit.

11. The arrangement of claim 10, wherein, when it is intended to achieve a given paper or board quality, the difference between the running speed used and the maximum running speed dependent on the evaporation capacity of the yankee cylinder is compensated for by the calendering unit, wherein the calendering unit placed after the yankee cylinder enables the running speed to be increased without the quality of the paper or board suffering in the form of reduced gloss and smoothness of the paper or board.

Applicant: Pekka Koivukunnas et al.  
PCT App. No.: PCT/FI00/00690

12. The arrangement of claim 10 wherein the calendering unit glazes a surface of the web glazed by the yankee cylinder.

13. An arrangement for surface treatment of a paper or board web in a paper or board machine comprising:  
a yankee cylinder; and  
an extended nip calendering unit positioned downstream of the yankee cylinder, wherein the web extends from the yankee cylinder to the extended nip calendering unit.

14. A method for surface treatment of a paper and/or board web in a paper or board machine comprising the steps of:  
running a yankee cylinder at a first running speed which is the maximum speed to obtain a given quality of web gloss and smoothness;  
increasing the running speed of the yankee cylinder beyond the first running speed to produce a web having a quality of web gloss and smoothness which is below the given quality; and  
immediately calendering the web which exits the yankee cylinder through a shoe or extended-nip calendering unit to impart the given quality of web gloss and smoothness to the web.

#### REMARKS

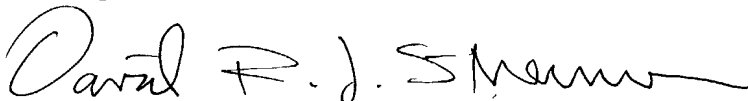
Claims 7–14 remain pending in the application.

Applicant believes that no new matter has been added by these amendments and

Applicant: Pekka Koivukunnas et al.  
PCT App. No.: PCT/FI00/00690

that the application, as amended, is ready for examination. Favorable action thereon is respectfully solicited.

Respectfully submitted,

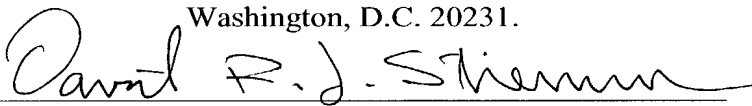


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In The United States Patent And Trademark Office

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For: Method and Arrangement for Surface Treatment of a Paper and/or Board  
Web

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|---|

**Marked Up Copy of Substitute Specification under 37 C.F.R. 1.125(b)(2)**

**TITLE OF THE INVENTION**

Method and [a]Arrangement for [s]Surface [t]Treatment [  
]of a [p]Paper and/or [b]Board [web]Web

**CROSS REFERENCES TO RELATED APPLICATIONS**

5    **[0001] This application is a U.S. national stage application of International  
Application No. PCT/FI00/00690, filed August 14, 2000, and claims priority on  
Finnish Application No. 19991802 filed August 24, 1999, the disclosures of both  
of which applications are incorporated by reference herein.**

**STATEMENT AS TO RIGHTS TO INVENTIONS MADE UNDER  
FEDERALLY SPONSORED RESEARCH AND DEVELOPMENT**

10    **Not applicable.**

## **BACKGROUND OF THE INVENTION**

**[0002]** The present invention relates to a method and arrangement for surface treatment of a paper and/or board web in a paper or board machine including a yankee cylinder followed by a calendering unit.

5 **[**

**[0003]** This kind of a machine is known from JP-A-05 331793. In the machine according to this JP-publication, the web's dried side is dried in the Yankee cylinder and the calendering unit being formed by soft calender. A soft calender has a short nip time, therefore final results, f[.ex.]**or example** web glazing, are difficult to  
10 manipulate.

**[0004]** Calendering is a method by means of which the properties, in particular smoothness and gloss, of a web-like material, such as a paper web, are improved after a drying unit in a paper or board machine. In calendering the paper web is passed into a nip which is formed between rolls pressed against each other and in  
15 which the paper web is deformed by the action of temperature, moisture and nip pressure, in which connection the physical properties of the paper web can be affected by controlling the above-mentioned parameters and the time of action.

**[0005]** Extended-nip calendering has been found to be a good means of producing low-gloss paper grades by calendering. When higher gloss is required, the nip  
20 pressure of extended-nip calendering does not necessarily suffice to provide gloss.

**[0006]** With ever-increasing running speeds, calendering is becoming a bottleneck in the papermaking process, and satisfactory quality is not achieved by today's machine calender units. Some of the drawbacks of the present papermaking process are also that the loss of bulk increases when gloss and smoothness are improved, and  
25 that in order to provide gloss and smoothness of sufficient quality, it is necessary to use webs with an abundance of coating and/or to use off-line calendering, in particular multi-nip supercalendering and/or soft calendering.



**[0007]** Machine calendering means here and hereafter calendering in a calender unit in which nips are formed between metal rolls. The width of the nip in a machine calender is typically very small depending on the width of the rolls and the thickness of the paper web to be calendered, wherefore the nip load is relatively high.

5 **[0008]** Supercalendering, which provides in off-line operation in practice the best result qualitywise, means above and hereafter calendering in a calender unit in which nips are formed between a metal or chilled thermoroll and a paper or polymer roll provided with a resilient surface, in which connection a nip of a substantial width is formed.

10 **[0009]** Soft calendering means above and hereafter calendering in a calender unit in which nips are formed in a manner similar to that of a supercalender between a metal or chilled roll and a roll having a resilient surface, in which connection a nip of a substantial width is formed. In soft calenders, each nip is formed between separate roll pairs, so that the nip load can be adjusted in each individual nip.

15 **[0010]** Shoe and/or extended-nip calendering means above and hereafter calendering in a calender unit in which a nip is formed between a roll provided with a flexible mantle, the mantle of said roll being made, for example, of polyurethane, and a press roll or shoe roll which has a rigid mantle and is provided with an inside loading shoe and which is made of metal, such as steel. One extended-nip concept  
20 marketed by **[the applicant]Metso Paper, Inc.** is called OptiDwell™, which includes two different extended-nip calenders:

- [ ] OptiDwell Shoe™ calender based on shoe press technology,
- [ ] OptiDwell Belt™ calender based on roll/belt technology.

25 **[0011]** A yankee cylinder represents a drying and glazing method known in the art for a long time, and the aim of the yankee cylinder is primarily to improve gloss but not to evaporate water. Yankee cylinders are employed mainly on paper and board machines which manufacture high-quality folding boxboards and envelope paper.

On the yankee cylinder, the moisture of the web is about 65 % at the most when it sticks to the surface of the cylinder and about 7–10 % at the most when it is separated from the surface of the cylinder. The main problem with the yankee cylinder is, thus, its speed dependence. The evaporation capacity of the yankee cylinder is limited, so when the speed is increased, the surface of the web is no longer glazed to a satisfactory degree.

### **SUMMARY OF THE INVENTION**

**[0012]** The primary object of the present invention is to provide an improvement in this detrimental speed dependence which is characteristic of the yankee cylinder and, with the improvement, to make it possible to increase speed without the quality, i.e. gloss and smoothness of paper or board suffering.

**[This objective is achieved according to the invention by means of a method and an arrangement of the kind mentioned at the beginning, the principal special features of the method being set forth in the characterizing part of the accompanying independent claim 1, and the principal special features of the arrangement being set forth in the characterising part of the accompanying independent claim 4.]**

**[0013]** Thus, the invention is based on the new and inventive basic idea that, after the web has been dried and glazed on a yankee cylinder, the web is glaze-calendered by using a shoe and/or extended-nip calendering unit as a calender placed after the yankee cylinder in accordance with an embodiment of the invention which is regarded as advantageous.

**[0014]** In accordance with an embodiment of the invention considered to be particularly advantageous, the method employs and the arrangement comprises a combination in which there are disposed in the machine direction first a yankee cylinder and then a shoe calendering unit which serves as a glazing calender.

**[With respect to the other characteristic features peculiar to the invention and**

the advantages attainable by them reference is made to the dependent claims of the accompanying set of claims.

**[0015]** The invention and the advantages which can be attained by it are described below by way of example by means of an embodiment of the invention regarded as advantageous with reference to the accompanying drawing[, t].

### **BRIEF DESCRIPTION OF THE DRAWINGS**

**[0016]** The figure[ of which] schematically shows an arrangement according to an advantageous embodiment of the invention for surface treatment of paper and/or board.

[  
]

### **DESCRIPTION OF THE PREFERRED EMBODIMENTS**

**[0017]** The arrangement according to the embodiment shown in the figure for surface treatment of a paper and/or board web W comprises a yankee cylinder 2 and a calendering unit 5 placed after it in the direction of processing of the web W, said calendering unit being in the embodiment shown in the figure a single nip glazing-calendering unit whose extended nip is formed between a metal or chilled thermoroll 51 provided with a rigid mantle and a shoe roll 52 provided with a flexible mantle. The shoe roll 52 comprises an inside glide shoe which, when supported on the inside frame structure of the shoe roll 52, presses the flexible mantle of the shoe roll 52 or a roll/belt structure placed around the shoe roll (not shown in the figure) against the thermoroll 51 having a rigid mantle. When it is intended to achieve a given paper or board quality, the difference between the running speed used in the machine and the running speed allowed by the evaporation capacity of the yankee cylinder can be compensated for by means of the glazing calender unit 5, i.e. the use of the glazing calender unit 5 enables the speed of the machine to be increased without the quality, that is, gloss and smoothness of paper or board suffering.

**[0018]** The web W to be treated is passed as a supported or free draw into a nip

defined between the yankee cylinder 2 having a smooth surface and a wire or press roll 1 having a rubber surface, as shown in the figure, or into nips defined between the yankee cylinder 2 and two wire or press rolls placed one after the other in the machine direction. Said nip/nips has/have no primary dewatering function but their primary function is glazing, and in addition thereto, the web W sticks to the surface of the yankee cylinder 2 by means of the wire or press roll 1. After the nip between the yankee cylinder 2 and the wire or press roll 1, the web W runs onwards on the surface of the yankee cylinder 2, on which a steam pressure of about 350 kPa acts on the outer surface of the web inside a hood 6, said pressure producing an evaporation capacity of 30–50 kg/m<sup>2</sup>, which dries the web from an incoming moisture which is typically 65–50 % but preferably not more than 70–80 % to a final moisture which is typically 7–10 %.

**[0019]** The web W is separated from the surface of the yankee cylinder 2 by means of a doctor device 3 and a take-out roll 4. After the doctor device 3 and the take-out roll 4, the web W is guided into the extended nip between the rigid-mantle roll 51 and the flexible-mantle roll 52 of the shoe or extended-nip calendering unit 5. The shoe calendering unit 5, disposed after the yankee cylinder 2 in accordance with the invention, functions in the arrangement of the invention as a glazing calender which allows, without the desired quality of paper or board suffering because of the limited evaporation capacity of the yankee cylinder 2, the running speed used in the machine to be raised to a higher level than said maximum running speed dependent on the evaporation capacity of the yankee cylinder 2. Advantageously, the “gloss surface” of the web glazed on the yankee cylinder 2 is glazed in this calendering unit 5.

**[0020]** The web W can be wound after the glazing carried out by means of the shoe calender 5.

**[0021]** Based on the trial run results of the arrangement according to the invention, it has been possible to establish generally that the quality values of the web are improved, i.e. the bending resistance of the web in relation to the thickness of the

web remains unchanged, its PPS roughness decreases and Hunter gloss improves when the yankee cylinder is followed by shoe calendering, and further that the improvement of the quality values is the clearer, the higher the linear load in the nip of the shoe calender. Some quality values as a function of the shoe calender are further shown below in table form.

**[0022]** Table: attained quality values

| PROPERTY                      | yankee glazed | yankee glazed and shoe calender treatment 200 kN/m | yankee glazed and shoe calender treatment 400 kN/m |
|-------------------------------|---------------|--|--|
| Thickness, [im] <u>μm</u>     | [<br>]125     | 121  | 117  |
| Bending resistance ks, mN     | [<br>]150     | 143  | 126  |
| PPS roughness, [im] <u>μm</u> | [<br>]4.2     | 3.4  | 2.9  |
| Hunter gloss, %               | [<br>]26      | 30   | 33   |

**[0023]** Above, the invention has been described only by way of example by means of some of its embodiments regarded as advantageous. This is of course not intended to limit the invention and, as is clear to a person skilled in the art, many alternative arrangements and modifications are feasible within the inventive idea and its scope of protection defined in the accompanying claims.


**ABSTRACT OF THE DISCLOSURE****[Abstract**

**The present invention relates to a]A method and an arrangement for surface treatment of a paper and/or board web (W)[. In accordance with the invention, the**  
5 **arrangement is]** formed of a yankee cylinder (2) and a calendering unit (5) placed one after the other in the machine direction, by means of which the web (W) is first glazed and dried and after that immediately calendered.[

**(FIG.)]**

In The United States Patent And Trademark Office

Applicant: Pekka Koivukunnas et al. Date: February 22, 2002  
Date Filed: Simultaneously herewith Docket No.: FORSAL-35  
PCT App. No.: PCT/FI00/00690  
For: Method and Arrangement for Surface Treatment of a Paper and/or Board Web

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|---|

**Clean Copy of Substitute Specification under 37 C.F.R. 1.125(c)**

TITLE OF THE INVENTION

Method and Arrangement for Surface Treatment of a Paper and/or Board Web

CROSS REFERENCES TO RELATED APPLICATIONS

5 [0001] This application is a U.S. national stage application of International Application No. PCT/FI00/00690, filed August 14, 2000, and claims priority on Finnish Application No. 19991802 filed August 24, 1999, the disclosures of both of which applications are incorporated by reference herein.

STATEMENT AS TO RIGHTS TO INVENTIONS MADE UNDER  
FEDERALLY SPONSORED RESEARCH AND DEVELOPMENT

10 Not applicable.

## BACKGROUND OF THE INVENTION

[0002] The present invention relates to a method and arrangement for surface treatment of a paper and/or board web in a paper or board machine including a yankee cylinder followed by a calendering unit.

5 [0003] This kind of a machine is known from JP-A-05 331793. In the machine according to this JP-publication, the web's dried side is dried in the Yankee cylinder and the calendering unit being formed by soft calender. A soft calender has a short nip time, therefore final results, for example web glazing, are difficult to manipulate.

10 [0004] Calendering is a method by means of which the properties, in particular smoothness and gloss, of a web-like material, such as a paper web, are improved after a drying unit in a paper or board machine. In calendering the paper web is passed into a nip which is formed between rolls pressed against each other and in which the paper web is deformed by the action of temperature, moisture and nip pressure, in which connection the physical properties of the paper web can be  
15 affected by controlling the above-mentioned parameters and the time of action.

[0005] Extended-nip calendering has been found to be a good means of producing low-gloss paper grades by calendering. When higher gloss is required, the nip pressure of extended-nip calendering does not necessarily suffice to provide gloss.

20 [0006] With ever-increasing running speeds, calendering is becoming a bottleneck in the papermaking process, and satisfactory quality is not achieved by today's machine calender units. Some of the drawbacks of the present papermaking process are also that the loss of bulk increases when gloss and smoothness are improved, and that in order to provide gloss and smoothness of sufficient quality, it is necessary to use webs with an abundance of coating and/or to use off-line calendering, in  
25 particular multi-nip supercalendering and/or soft calendering.

[0007] Machine calendering means here and hereafter calendering in a calender unit in which nips are formed between metal rolls. The width of the nip in a machine



calender is typically very small depending on the width of the rolls and the thickness of the paper web to be calendered, wherefore the nip load is relatively high.

[0008] Supercalendering, which provides in off-line operation in practice the best result qualitywise, means above and hereafter calendering in a calender unit in which nips are formed between a metal or chilled thermoroll and a paper or polymer roll provided with a resilient surface, in which connection a nip of a substantial width is formed.

[0009] Soft calendering means above and hereafter calendering in a calender unit in which nips are formed in a manner similar to that of a supercalender between a metal or chilled roll and a roll having a resilient surface, in which connection a nip of a substantial width is formed. In soft calenders, each nip is formed between separate roll pairs, so that the nip load can be adjusted in each individual nip.

[0010] Shoe and/or extended-nip calendering means above and hereafter calendering in a calender unit in which a nip is formed between a roll provided with a flexible mantle, the mantle of said roll being made, for example, of polyurethane, and a press roll or shoe roll which has a rigid mantle and is provided with an inside loading shoe and which is made of metal, such as steel. One extended-nip concept marketed by Metso Paper, Inc. is called OptiDwell™, which includes two different extended-nip calenders:

- OptiDwell Shoe™ calender based on shoe press technology,
- OptiDwell Belt™ calender based on roll/belt technology.

[0011] A yankee cylinder represents a drying and glazing method known in the art for a long time, and the aim of the yankee cylinder is primarily to improve gloss but not to evaporate water. Yankee cylinders are employed mainly on paper and board machines which manufacture high-quality folding boxboards and envelope paper. On the yankee cylinder, the moisture of the web is about 65 % at the most when it sticks to the surface of the cylinder and about 7–10 % at the most when it is

separated from the surface of the cylinder. The main problem with the yankee cylinder is, thus, its speed dependence. The evaporation capacity of the yankee cylinder is limited, so when the speed is increased, the surface of the web is no longer glazed to a satisfactory degree.

5

#### SUMMARY OF THE INVENTION

[0012] The primary object of the present invention is to provide an improvement in this detrimental speed dependence which is characteristic of the yankee cylinder and, with the improvement, to make it possible to increase speed without the quality, i.e. gloss and smoothness of paper or board suffering.

10

[0013] Thus, the invention is based on the new and inventive basic idea that, after the web has been dried and glazed on a yankee cylinder, the web is glaze-calendered by using a shoe and/or extended-nip calendering unit as a calender placed after the yankee cylinder in accordance with an embodiment of the invention which is regarded as advantageous.

15

[0014] In accordance with an embodiment of the invention considered to be particularly advantageous, the method employs and the arrangement comprises a combination in which there are disposed in the machine direction first a yankee cylinder and then a shoe calendering unit which serves as a glazing calender.

20

[0015] The invention and the advantages which can be attained by it are described below by way of example by means of an embodiment of the invention regarded as advantageous with reference to the accompanying drawing.

#### BRIEF DESCRIPTION OF THE DRAWINGS

25

[0016] The figure schematically shows an arrangement according to an advantageous embodiment of the invention for surface treatment of paper and/or board.

#### DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0017] The arrangement according to the embodiment shown in the figure for surface treatment of a paper and/or board web W comprises a yankee cylinder 2 and a calendering unit 5 placed after it in the direction of processing of the web W, said calendering unit being in the embodiment shown in the figure a single nip glazing-calendering unit whose extended nip is formed between a metal or chilled thermoroll 51 provided with a rigid mantle and a shoe roll 52 provided with a flexible mantle. The shoe roll 52 comprises an inside glide shoe which, when supported on the inside frame structure of the shoe roll 52, presses the flexible mantle of the shoe roll 52 or a roll/belt structure placed around the shoe roll (not shown in the figure) against the thermoroll 51 having a rigid mantle. When it is intended to achieve a given paper or board quality, the difference between the running speed used in the machine and the running speed allowed by the evaporation capacity of the yankee cylinder can be compensated for by means of the glazing calender unit 5, i.e. the use of the glazing calender unit 5 enables the speed of the machine to be increased without the quality, that is, gloss and smoothness of paper or board suffering.

[0018] The web W to be treated is passed as a supported or free draw into a nip defined between the yankee cylinder 2 having a smooth surface and a wire or press roll 1 having a rubber surface, as shown in the figure, or into nips defined between the yankee cylinder 2 and two wire or press rolls placed one after the other in the machine direction. Said nip/nips has/have no primary dewatering function but their primary function is glazing, and in addition thereto, the web W sticks to the surface of the yankee cylinder 2 by means of the wire or press roll 1. After the nip between the yankee cylinder 2 and the wire or press roll 1, the web W runs onwards on the surface of the yankee cylinder 2, on which a steam pressure of about 350 kPa acts on the outer surface of the web inside a hood 6, said pressure producing an evaporation capacity of 30–50 kg/m<sup>2</sup>, which dries the web from an incoming moisture which is typically 65–50 % but preferably not more than 70–80 % to a final moisture which is typically 7–10 %.

[0019] The web W is separated from the surface of the yankee cylinder 2 by means

of a doctor device 3 and a take-out roll 4. After the doctor device 3 and the take-out roll 4, the web W is guided into the extended nip between the rigid-mantle roll 51 and the flexible-mantle roll 52 of the shoe or extended-nip calendering unit 5. The shoe calendering unit 5, disposed after the yankee cylinder 2 in accordance with the invention, functions in the arrangement of the invention as a glazing calender which allows, without the desired quality of paper or board suffering because of the limited evaporation capacity of the yankee cylinder 2, the running speed used in the machine to be raised to a higher level than said maximum running speed dependent on the evaporation capacity of the yankee cylinder 2. Advantageously, the “gloss surface” of the web glazed on the yankee cylinder 2 is glazed in this calendering unit 5.

[0020] The web W can be wound after the glazing carried out by means of the shoe calender 5.

[0021] Based on the trial run results of the arrangement according to the invention, it has been possible to establish generally that the quality values of the web are improved, i.e. the bending resistance of the web in relation to the thickness of the web remains unchanged, its PPS roughness decreases and Hunter gloss improves when the yankee cylinder is followed by shoe calendering, and further that the improvement of the quality values is the clearer, the higher the linear load in the nip of the shoe calender. Some quality values as a function of the shoe calender are further shown below in table form.

[0022] Table: attained quality values

| PROPERTY                      | yankee glazed | yankee glazed and shoe calender treatment 200 kN/m | yankee glazed and shoe calender treatment 400 kN/m |
|-------------------------------|---------------|--|--|
| Thickness, $\mu\text{m}$      | 125           | 121  | 117  |
| Bending resistance $k_s$ , mN | 150           | 143  | 126  |
| PPS roughness, $\mu\text{m}$  | 4.2           | 3.4  | 2.9  |
| Hunter gloss, %               | 26            | 30   | 33   |

[0023] Above, the invention has been described only by way of example by means of some of its embodiments regarded as advantageous. This is of course not intended to limit the invention and, as is clear to a person skilled in the art, many alternative arrangements and modifications are feasible within the inventive idea and its scope  
5 of protection defined in the accompanying claims.

## ABSTRACT OF THE DISCLOSURE

A method and an arrangement for surface treatment of a paper and/or board web (W) formed of a yankee cylinder (2) and a calendering unit (5) placed one after the other in the machine direction, by means of which the web (W) is first glazed and dried  
5 and after that immediately calendered.

Method and arrangement for surface treatment  
of a paper and/or board web

5

The present invention relates to a method and arrangement for surface treatment of a paper and/or board web in a paper or board machine including a yankee cylinder followed by a calendering unit.

10

This kind of a machine is known from JP-A-05 331793. In the machine according to this JP-publication, the web's dried side is dried in the Yankee cylinder and the calendering unit being formed by soft calender. A soft calender has a short nip time, therefore final results, f.ex. web glazing, are difficult to manipulate.

15

Calendering is a method by means of which the properties, in particular smoothness and gloss, of a web-like material, such as a paper web, are improved after a drying unit in a paper or board machine. In calendering the paper web is passed into a nip which is formed between rolls pressed against each other and in which the paper web  
20 is deformed by the action of temperature, moisture and nip pressure, in which connection the physical properties of the paper web can be affected by controlling the above-mentioned parameters and the time of action.

Extended-nip calendering has been found to be a good means of producing low-gloss  
25 paper grades by calendering. When higher gloss is required, the nip pressure of extended-nip calendering does not necessarily suffice to provide gloss.

With ever-increasing running speeds, calendering is becoming a bottleneck in the papermaking process, and satisfactory quality is not achieved by today's machine  
30 calender units. Some of the drawbacks of the present papermaking process are also that the loss of bulk increases when gloss and smoothness are improved, and that in order to provide gloss and smoothness of sufficient quality, it is necessary to use webs





surface of the cylinder. The main problem with the yankee cylinder is, thus, its speed dependence. The evaporation capacity of the yankee cylinder is limited, so when the speed is increased, the surface of the web is no longer glazed to a satisfactory degree.

- 5 The primary object of the present invention is to provide an improvement in this detrimental speed dependence which is characteristic of the yankee cylinder and, with the improvement, to make it possible to increase speed without the quality, i.e. gloss and smoothness of paper or board suffering.
- 10 This objective is achieved according to the invention by means of a method and an arrangement of the kind mentioned at the beginning, the principal special features of the method being set forth in the characterizing part of the accompanying independent claim 1, and the principal special features of the arrangement being set forth in the characterising part of the accompanying independent claim 4.

15

Thus, the invention is based on the new and inventive basic idea that, after the web has been dried and glazed on a yankee cylinder, the web is glaze-calendered by using a shoe and/or extended-nip calendering unit as a calender placed after the yankee cylinder in accordance with an embodiment of the invention which is regarded as  
20 advantageous.

In accordance with an embodiment of the invention considered to be particularly advantageous, the method employs and the arrangement comprises a combination in which there are disposed in the machine direction first a yankee cylinder and then a  
25 shoe calendering unit which serves as a glazing calender.

With respect to the other characteristic features peculiar to the invention and the advantages attainable by them reference is made to the dependent claims of the accompanying set of claims.

30

The invention and the advantages which can be attained by it are described below by way of example by means of an embodiment of the invention regarded as advantage-

ous with reference to the accompanying drawing, the figure of which schematically shows an arrangement according to an advantageous embodiment of the invention for surface treatment of paper and/or board.

5 The arrangement according to the embodiment shown in the figure for surface treatment of a paper and/or board web W comprises a yankee cylinder 2 and a calendering unit 5 placed after it in the direction of processing of the web W, said calendering unit being in the embodiment shown in the figure a single nip glazing-calendering unit whose extended nip is formed between a metal or chilled thermoroll  
10 51 provided with a rigid mantle and a shoe roll 52 provided with a flexible mantle. The shoe roll 52 comprises an inside glide shoe which, when supported on the inside frame structure of the shoe roll 52, presses the flexible mantle of the shoe roll 52 or a roll/belt structure placed around the shoe roll (not shown in the figure) against the thermoroll 51 having a rigid mantle. When it is intended to achieve a given paper or  
15 board quality, the difference between the running speed used in the machine and the running speed allowed by the evaporation capacity of the yankee cylinder can be compensated for by means of the glazing calender unit 5, i.e. the use of the glazing calender unit 5 enables the speed of the machine to be increased without the quality, that is, gloss and smoothness of paper or board suffering.

20

The web W to be treated is passed as a supported or free draw into a nip defined between the yankee cylinder 2 having a smooth surface and a wire or press roll 1 having a rubber surface, as shown in the figure, or into nips defined between the yankee cylinder 2 and two wire or press rolls placed one after the other in the  
25 machine direction. Said nip/nips has/have no primary dewatering function but their primary function is glazing, and in addition thereto, the web W sticks to the surface of the yankee cylinder 2 by means of the wire or press roll 1. After the nip between the yankee cylinder 2 and the wire or press roll 1, the web W runs onwards on the surface of the yankee cylinder 2, on which a steam pressure of about 350 kPa acts on  
30 the outer surface of the web inside a hood 6, said pressure producing an evaporation capacity of 30—50 kg/m<sup>2</sup>, which dries the web from an incoming moisture which is typically 65—50 % but preferably not more than 70—80 % to a final moisture which

is typically 7—10 %.

The web W is separated from the surface of the yankee cylinder 2 by means of a doctor device 3 and a take-out roll 4. After the doctor device 3 and the take-out roll 4, the web W is guided into the extended nip between the rigid-mantle roll 51 and the flexible-mantle roll 52 of the shoe or extended-nip calendering unit 5. The shoe calendering unit 5, disposed after the yankee cylinder 2 in accordance with the invention, functions in the arrangement of the invention as a glazing calender which allows, without the desired quality of paper or board suffering because of the limited evaporation capacity of the yankee cylinder 2, the running speed used in the machine to be raised to a higher level than said maximum running speed dependent on the evaporation capacity of the yankee cylinder 2. Advantageously, the "gloss surface" of the web glazed on the yankee cylinder 2 is glazed in this calendering unit 5.

The web W can be wound after the glazing carried out by means of the shoe calender 5.

Based on the trial run results of the arrangement according to the invention, it has been possible to establish generally that the quality values of the web are improved, i.e. the bending resistance of the web in relation to the thickness of the web remains unchanged, its PPS roughness decreases and Hunter gloss improves when the yankee cylinder is followed by shoe calendering, and further that the improvement of the quality values is the clearer, the higher the linear load in the nip of the shoe calender. Some quality values as a function of the shoe calender are further shown below in table form.

Table: attained quality values

| PROPERTY                 | yankee glazed | yankee glazed and shoe calender treatment 200 kN/m | yankee glazed and shoe calender treatment 400 kN/m |
|--------------------------|---------------|--|--|
| Thickness, $\mu\text{m}$ | 125           | 121  | 117  |
| Bending resistance       |               |  |  |

|                      |     |     |     |
|----------------------|-----|-----|-----|
| ks, mN               | 150 | 143 | 126 |
| PPS roughness,<br>µm | 4.2 | 3.4 | 2.9 |
| Hunter gloss, %      | 26  | 30  | 33  |

Above, the invention has been described only by way of example by means of some of its embodiments regarded as advantageous. This is of course not intended to limit the invention and, as is clear to a person skilled in the art, many alternative arrangements and modifications are feasible within the inventive idea and its scope of protection defined in the accompanying claims.

1. A method for surface treatment of a paper and/or board web (W) in a paper or board machine including a yankee cylinder (2) followed by a calendering unit (5), characterized in that the web (W) is glazed and dried first by means of a yankee cylinder (2), after which the web is immediately calendered by means of a shoe or extended-nip calendering unit (5).

2. A method according to claim 1, characterized in that, when it is intended to achieve a given paper or board quality, the difference between the running speed used and the maximum running speed dependent on the evaporation capacity of the yankee cylinder (2) is compensated for by means of calendering, i.e. calendering after the yankee cylinder enables the running speed of the yankee cylinder to be increased without the quality, that is, gloss and smoothness of paper or board suffering.

15

3. A method according to claim 1, characterized in that the surface of the web (W) glazed by means of the yankee cylinder (2) is glazed in the calendering unit (5).

4. An arrangement for surface treatment of paper and/or board in a paper or board machine including a yankee cylinder (2) followed by a calendering unit (5), characterized in that the arrangement is formed of a combination in which there is disposed in the machine direction first a yankee cylinder (2) and then a calendering unit (5), which is formed by a shoe or extended-nip calendering unit (5).

25 5. An arrangement according to claim 4, characterized in that, when it is intended to achieve a given paper or board quality, the difference between the running speed used and the maximum running speed dependent on the evaporation capacity of the yankee cylinder (2) is compensated for by means of the calendering unit (5), i.e. the calendering unit placed after the yankee cylinder enables the running speed to be  
30 increased without the quality, that is, gloss and smoothness of paper or board suffering.



## (12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization  
International Bureau(43) International Publication Date  
1 March 2001 (01.03.2001)

PCT

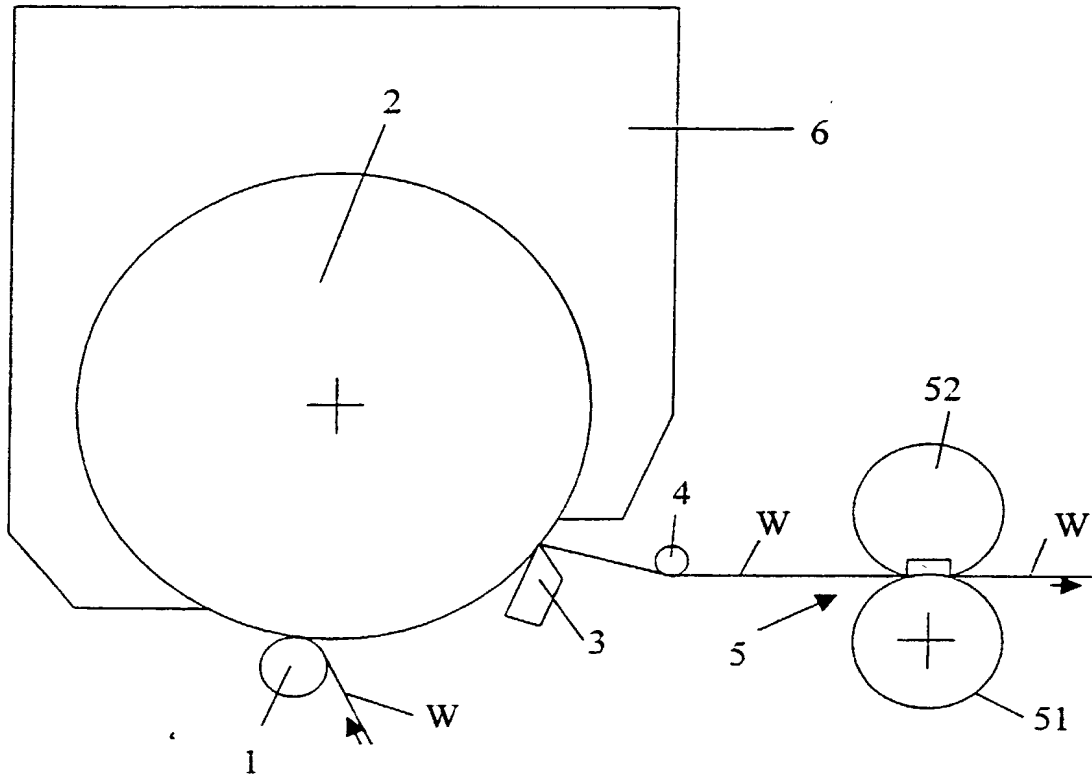
(10) International Publication Number  
**WO 01/14637 A2**

- (51) International Patent Classification<sup>7</sup>: **D21H 19/00**
- (21) International Application Number: **PCT/FI00/00690**
- (22) International Filing Date: **14 August 2000 (14.08.2000)**
- (25) Filing Language: **English**
- (26) Publication Language: **English**
- (30) Priority Data:  
19991802      24 August 1999 (24.08.1999)      **FI**
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- (81) Designated States (*national*): AE, AG, AL, AM, AT, AT (utility model), AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, CZ (utility model), DE, DE (utility model), DK, DK (utility model), DM, DZ, EE, EE (utility model), ES, FI, FI (utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (utility model), SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.
- (84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).
- Published:**  
— Without international search report and to be republished upon receipt of that report.
- For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

(54) Title: METHOD AND ARRANGEMENT FOR SURFACE TREATMENT OF A PAPER AND/OR BOARD WEB

(57) Abstract: The present invention relates to a method and an arrangement for surface treatment of a paper and/or board web (W). In accordance with the invention, the arrangement is formed of a yankee cylinder (2) and a calendering unit (5) placed one after the other in the machine direction, by means of which the web (W) is first glazed and dried and after that immediately calendered.

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| Filing Date            | August 14, 2000           |
| First Named Inventor   | Pekka Koivukunnas         |
| Title                  | Method and Arrangement... |
| Group Art Unit         |                           |
| Examiner Name          |                           |
| Attorney Docket Number | FORSAL-35                 |

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Name

Matti Lares

Signature



Date

13/3/2002

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| Filing Date            | August 14, 2000           |
| First Named Inventor   | Pekka Koivukunnas         |
| Title                  | Method and Arrangement... |
| Group Art Unit         |                           |
| Examiner Name          |                           |
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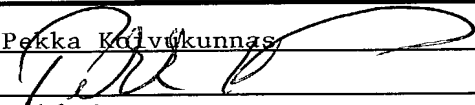
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☒ Applicant/Inventor.

☐ Assignee of record of the entire interest. See 37 CFR 3.71.  
Statement under 37 CFR 3.73(b) is enclosed. (Form PTO/SB/96).
**SIGNATURE of Applicant or Assignee of Record**

|           |   |
|-----------|---|
| Name      | Pekka Koivukunnas   |
| Signature |  |
| Date      | 13.3.2002   |

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|-------------------------------|--------------------|
| <b>Attorney Docket Number</b> | FORSAL-35          |
| <b>First Named Inventor</b>   | Koivukunnas, Pekka |
| <b>COMPLETE IF KNOWN</b>      |                    |
| <b>Application Number</b>     | 10/069,203         |
| <b>Filing Date</b>            |                    |
| <b>Art Unit</b>               |                    |
| <b>Examiner Name</b>          |                    |

**As the below named inventor, I hereby declare that:**

My residence, mailing address, and citizenship are as stated below next to my name.

I believe I am the original and first inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled:

**METHOD AND ARRANGEMENT FOR SURFACE TREATMENT OF A PAPER AND/OR  
BOARD WEB**

(Title of the Invention)

the specification of which

☐ is attached hereto

OR

☒ was filed on (MM/DD/YYYY) **August 14, 2000** as United States Application Number or PCT International

Application Number **PCT/FI00/00690** and was amended on (MM/DD/YYYY) **February 22, 2002** (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or (f), or 365(b) of any foreign application(s) for patent, inventor's or plant breeder's rights certificate(s), or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent, inventor's or plant breeder's rights certificate(s), or any PCT international application having a filing date before that of the application on which priority is claimed.

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☐ Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto:

[Page 1 of 2]

10069203 1071002

PTO/SB/01 (10-01)

Approved for use through 10/31/2002. OMB 0651-0032

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ZIP FIN-00240Country Finland☐ Additional inventors are being named on the 0 supplemental Additional Inventor(s) sheet(s) PTO/SB/02A attached hereto.